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Approved for Release

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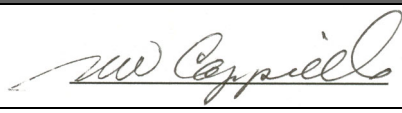
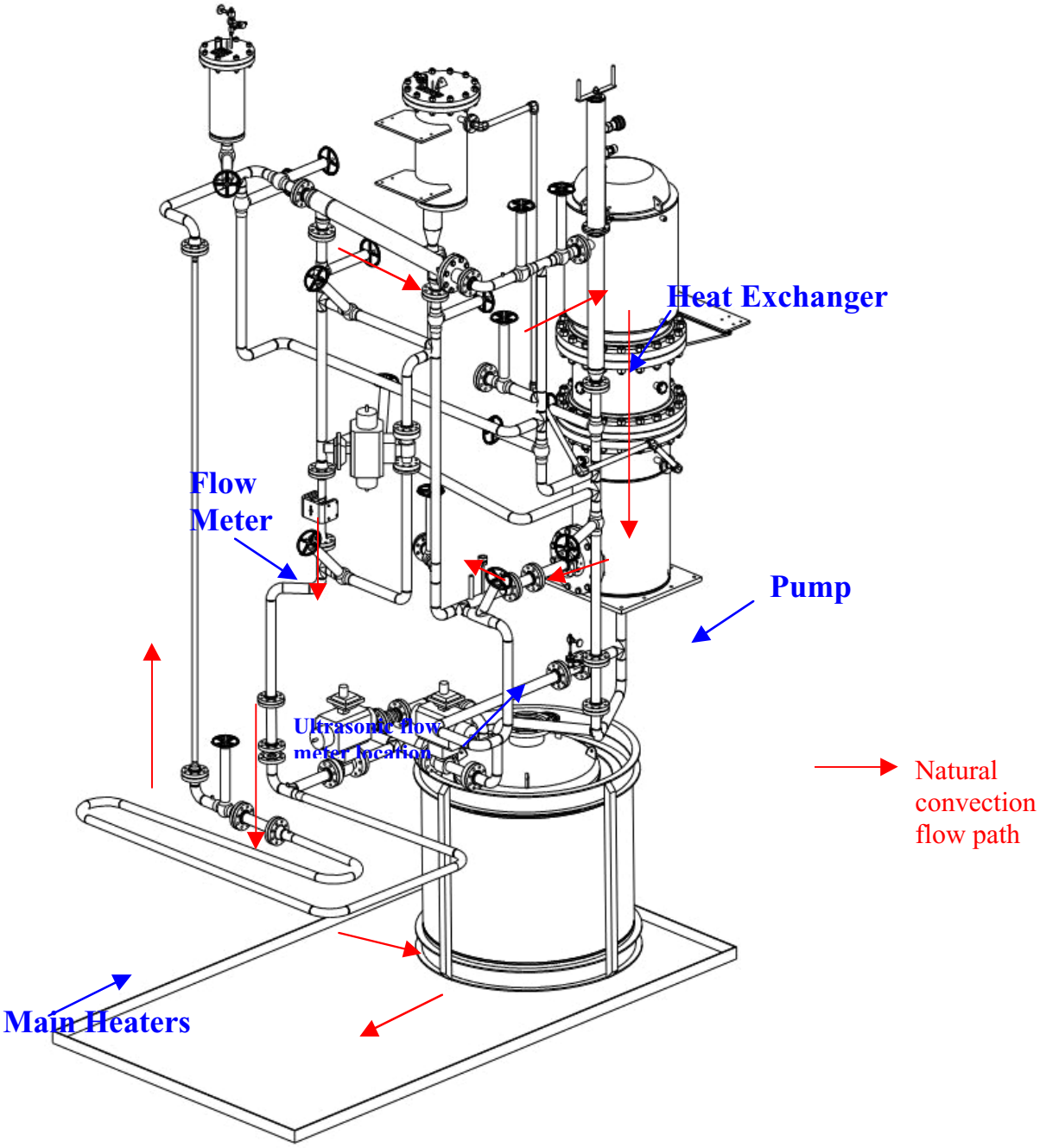
LANL Program Manager:	Michael W. Cappiello	9/29/03	

DELTA Loop Thermohydraulic Test Plan for FY 2004



1 Natural Convection

1.1 Goals.

Create and maintain a flow of liquid lead-bismuth driven entirely by natural convection. Benchmark thermohydraulic codes such as TRAC in natural convection mode.
Duration: 3 weeks.

1.2 Activities.

1.2.1 Run LBE flow with the pump for a period of time.
1.2.2 Stop; reconfigure the flow path to bypass the pump.
1.2.3 Turn on the main heaters and turn on water to the heat exchanger to start increasing the driving temperature gradient.
1.2.4 Establish a natural convection flow and maintain it for several hours.
1.2.5 Run natural convection flow with 25%, 50%, 75% and 100% heat exchanger capacity.
1.2.6 Determine the highest flow speed attainable in the DELTA loop with natural convection flow and the corresponding loop conditions.

2 Max Temperature Gradient

2.1 Goals.

Determine the extreme temperature conditions attainable at DELTA loop.
Duration: 1 week.

2.2 Activities.

2.2.1 Run LBE flow using the pump.
2.2.2 Bring the hottest section of DELTA loop to its maximum allowable temperature (†550°C).
2.2.3 Open the heat exchanger to its 100% capacity.
2.2.4 Run for several hours to ensure that the temperature gradients stabilized.
2.2.5 Compare data to thermohydraulic codes predictions.
2.2.6 Repeat the test for at least 5 different flow speeds.

3 Liquid Lead-Bismuth Pipe Flow Heat Transfer

3.1 Goals.

Determine the relationship between the liquid lead-bismuth flow speed, temperature and pipe temperature. Calculate heat transfer coefficients. Compare to existing liquid metal heat transfer coefficients formulas.
Duration: 2 weeks.

3.2 Activities.

3.2.1 Analyze existing data for the purpose of heat transfer coefficient calculation. Ensure that the heat transfer tests do not repeat already existing data.
3.2.2 Ensure that calibrated thermocouples are used in the thermowells in DELTA loop piping.
3.2.3 Run the loop at various flow speeds and temperatures. At least four different flow speeds and four different temperature regimes should be used.

4 High temperature test section

4.1 Goals.

Determine the maximum temperature gradient achievable in DELTA loop with the high temperature test section. Determine heat transfer coefficients at temperatures above 550°C with the steel used for the high temperature test section.
Duration: 3 weeks.

4.2 Activities.

4.2.1 Install new high temperature test section.
4.2.2 Use several calibrated thermocouples in thermowells in the test section.
4.2.3 Run DELTA loop starting at low flow speed of about $2m^3$/hr up to maximum flow speed allowable by pressure limits (about $6m^3$/hr).
4.2.4 At each flow rate increase temperatures to maximum allowable in steps.
4.2.5 Allow the flow and temperature distribution to stabilize between temperature and flow rate increases.

5 Flow velocity measurement

5.1 Goals.

Study option for liquid lead-bismuth flow speed and flow velocity measurements. Investigate operations of a Doppler ultrasound flow profile meter in a liquid metal system.
Duration: 3 weeks.

5.2 Activities.

5.2.1 Install ultrasound flow measuring device on the DELTA loop s sump tank outlet pipe.
5.2.2 Run DELTA loop starting at low flow speed of about $2m^3$/hr up to maximum flow speed allowable by pressure limits (about $6m^3$/hr) or by the ultrasonic flow meter.
5.2.3 Allow the flow to stabilize between and flow rate increases.
5.2.4 Check operation of the ultrasonic flow meter at different temperatures.

6 Results

All data pertinent to the tests will be collected by the data acquisition system. All results will be collected in form of written reports.

The tests may be modified or new tests may be designed as needed by the DELTA loop operations or by the AFCI program. They may include investigation of other types of low meters, study of flow and heat transfer on specific geometries, etc.